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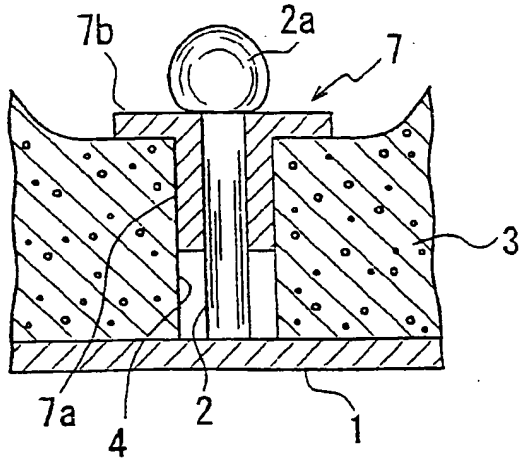
(54) ENERGY ABSORBER MOUNTING STRUCTURE

(57) An energy absorber mounting structure capable of mounting an energy absorber without using a hot melt adhesive agent and without producing loosening on those members such as a trims wherein a rod (2) is installed projectedly from a trim (1) and the rod (2) is inserted into a mounting hole (4) provided in the energy absorber (3). a cylindrical body (7) comprising a cylindrical part (7a) and an extension part (7b) formed integrally of each other is fitted onto the rod (2), the cylindrical part (7a) is fitted over the mounting hole (4) and the extension part (7b) covers the peripheral part of the mounting hole (4), the cylindrical body (7) is fitted over the rod (2) and the cylindrical body (7a) is fitted into the mounting hole (4) and, after the extension part (7b) is put on the energy absorber (3). crimping is applied to the tip side of the rod (2) so as to form an expanded part (2a).

Fig. 1



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Description

Field of the invention and related art statement

[0001] The present invention relates to mounting structure for an energy absorber and, more particularly, to the mounting structure for the energy absorber which can be suitably applied to a trim of an automobile.

[0002] For energy absorption in the event of a lateral collision, an energy absorber made of rigid urethane is mounted on a door trim of an automobile. As an example of method for mounting the energy absorber made of rigid urethane to the door trim, there is a method using caulking as shown in Figs. 6a and 6b. Fig. 6b is an enlarged view of a portion VIB of Fig. 6a.

[0003] A trim (door trim) 1' is provided with rods 2' projecting from an inner surface of the trim 1'. The rods 2' are inserted through mounting holes 4 formed in an energy absorber 3' for the event of the lateral collision. After flat washers are fitted onto the rods 2', the tops of the rods 2' are caulked to form enlarged portions 2'a. To prevent the backlash of the energy absorber 3', hot-melt adhesives 6 are affixed on a corner between the side periphery of the energy absorber 3' and the trim 1'.

[0004] Conventional structure as shown in Figs. 6a, 6b requires a step of caulking the rods 2' after the flat washers 5 are inserted and further a step of affixing the hot-melt adhesives 6, taking plenty of time and labor for mounting the energy absorber.

Object and summary of the invention

[0005] It is an object of the present invention to provide the mounting structure for an energy absorber for securely mounting an energy absorber to a member such as a trim without causing backlash and without using hot-melt adhesives.

[0006] In a first aspect of mounting structure for an energy absorber of the present invention, a rod projecting from a mounting surface of a member on which the energy absorber is mounted is inserted into a mounting hole of the energy absorber. A cylindrical member having a cylindrical portion and a flanged portion overhanging from the cylindrical portion is fitted onto the rod. The cylindrical portion is fitted into the mounting hole of the energy absorber and the flanged portion is overlapped with a peripheral portion about the mounting hole.

[0007] In the mounting structure for an energy absorber, the cylindrical portion of the cylindrical member is arranged between the inner surface of the mounting hole of the energy absorber and the outer surface of the rod, thereby preventing the backlash of the energy absorber in a direction along the mounting surface. The backlash of the energy absorber in a direction perpendicular to the mounting surface is prevented by the flanged portion of the cylindrical member which is overlapped with the peripheral portion about the mounting hole of the energy absorber. Therefore, the present invention allows the energy absorber to be mounted to the member such as a trim without using hot-melt adhesives.

[0008] In the present invention, the outer surface of the cylindrical portion is preferably in contact with the inner surface of the mounting hole of the energy absorber. As a result of this, the backlash of the energy absorber in the direction along the mounting surface can be further securely prevented.

[0009] In an embodiment of the present invention, the rod is provided with an enlarged portion at an end thereof whereby the cylindrical member is fastened to the rod.

[0010] In another embodiment of the present invention, the cylindrical portion is provided with slits extending from an end of the cylindrical portion, the cylindrical portion is provided with a pawl formed on an inner surface of a portion near the end of the cylindrical portion, the rod is provided with a concavity or convexity formed on an outer surface of the rod, and the pawl is engaged with the concavity or convexity whereby the cylindrical member is fastened to the rod.

[0011] A second aspect of mounting structure for an energy absorber of the present invention is for mounting an energy absorber to a member. The energy absorber has a mounting hole. The structure has an anchor projecting from a mounting surface of the member to enter the mounting hole, a pressing member having a flanged portion pressing the periphery of the mounting hole and a projection inserted into the mounting hole, a serrate portion provided to one of the anchor and the projection, and an engaging portion provided to the other of the anchor and the projection to engage with the serrate portion.

[0012] According to the mounting structure for an energy absorber of the second aspect, the backlash of the energy absorber in a direction perpendicular to the mounting surface is prevented by flanged portion of the pressing member which presses the periphery of the mounting hole of the energy absorber. The pressing member is designed so as to be in contact with the inner surface of the mounting hole of the energy absorber, thereby preventing the backlash of the energy absorber in a direction along the mounting surface.

[0013] According to the present invention, the cylindrical member may have a projection which is engaged with the energy absorber to prevent the rotation of the cylindrical member about the rod. The projection may be a pawl which cuts into the energy absorber.

Brief description of the drawings

[0014]

Fig. 1 is a sectional view showing mounting structure for an energy absorber according to one embodiment of the present invention;

Fig. 2 is a perspective view of a cylindrical member employed in the embodiment;

Fig. 3 is a perspective view of another variation of

the cylindrical member;
Fig. 4 is a perspective view of another variation of the cylindrical member;
Fig. 5 is a perspective view of another variation of the cylindrical member;
Fig. 6a is a sectional view showing a conventional mounting structure for an energy absorber to a door trim. and Fig. 6b is an enlarged view of a portion VIB in Fig. 6a;
Fig. 7 is a sectional view showing mounting structure for an energy absorber according to another embodiment of the present invention;
Fig. 8a is a perspective view of a cylindrical member employed in the embodiment of Fig. 7, and Fig. 8b is a sectional perspective view of the cylindrical member of Fig. 8a;
Fig. 9 is a sectional view showing mounting structure for an energy absorber according to further another embodiment of the present invention;
Fig. 10 is a sectional perspective view of a cylindrical member employed in the embodiment of Fig. 9;
Fig. 11 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention;
Fig. 12a is a perspective view of a cylindrical member employed in the embodiment of Fig. 11, and Fig. 12b is a sectional perspective view of the cylindrical member;
Fig. 13 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention;
Fig. 14 is a perspective view of a cylindrical member employed in the embodiment of Fig. 13;
Fig. 15 is a sectional view of a pile of the cylindrical members of Fig. 11;
Fig. 16 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention;
Fig. 17 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention;
Fig. 18 is an exploded view showing the structure of Fig. 17;
Fig. 19 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention;
and
Fig. 20 is a sectional view showing mounting structure for an energy absorber according to an embodiment of the present invention.

Description of preferred embodiments

[0015] Hereinafter, embodiments will be described with reference to attached drawings. Fig. 1 is a sectional view showing mounting structure for an energy absorber according to the first embodiment and shows a section of a portion similar to a portion shown in Fig. 6b. Fig. 2 is a perspective view of a cylindrical member employed in this embodiment.

[0016] In this embodiment. a trim 1 is provided with rods 2 which are inserted through mounting holes 4 formed in an energy absorber 3, respectively, in the same manner as the conventional one. In this embodiment, a cylindrical member 7 is put on the rod 2. The cylindrical member 7 comprises a cylindrical portion 7a and a flangec portion 7b integrally. The cylindrical portion 7a is fitted onto the rod 2 and the flanged portion 7b is overlapped with the peripheral portion about the mounting hole 4. The cylindrical member 7 is put on the rod 2 in such a manner that the cylindrical portion 7a is fitted into the mounting hole 4 and the flanged portion 7b is laid on the energy absorber 3. After that, the top end of the rod 2 is caulked to form an enlarged portion 2a.

[0017] As a result of this. the energy absorber 3 is mounted to the trim 1 without causing backlash. That is, the movement of the energy absorber 3 in a direction along the surface of the trim 1 is prevented by the respective cylindrical portions 7a arranged between the rods 2 and the inner surfaces of the mounting holes 4. The movement of the energy absorber 3 in a direction perpendicular to the surface of the trim 1 is prevented by the flanged portions 7b of the cylindrical members 7. Therefore. unlike the conventional one of Figs. 6a, 6b, hot-melt adhesives are not required, thereby facilitating the work of mounting the energy absorber 3. In case of mounting the energy absorber to a car trim, the number of the rods or the mounting holes are preferably 2-6, more preferably 2-4 per one energy absorber.

[0018] The diameter (outer diameter) of the cylindrical portion 7a of the cylindrical member 7 is preferably ±1 mm, more preferably ±0.5 mm relative to the diameter (inner diameter) of the mounting hole 4 of the energy absorber 3 before the insertion of the cylindrical portion 7a. The diameter (outer diameter) of the cylindrical portion 7a is preferably 5-12 mm. more preferably 5-10 mm. The diameter (inner diameter) of the cylindrical member 7 is preferably larger than the outer diameter of the rod 2 by 0.1-2.0 mm, more preferably by 0.5-1.0 mm.

[0019] The length of the cylindrical member 7 in the longitudinal direction is preferably 25-100 %, more preferably 40-80 % of the length of the mounting hole 4 in the longitudinal direction. In case of the energy absorber made of rigid urethane, the length of the mounting hole 4 in the longitudinal direction is preferably 4 mm or more, while the cylindrical portion 7a of the cylindrical member 7 in the axial direction thereof is preferably 3 mm or more, more preferably, 10-15 mm.

[0020] The diameter (outer diameter) of the flanged portion 7b is preferably larger than the diameter (inner diameter) of the mounting hole 4 by 8-15 mm. The thickness of the flanged portion 7b is preferably 0.5 mm or more, for example 0.5-2 mm. The material of the cylindrical member 7 is metal or synthetic resin. The synthetic resin may be polypropylene. ABS, or the like.

[0021] Though the flanged portion 7b of the cylindrical member 7 is formed in a disc-like configuration in Figs. 1 and 2, the flanged portion 7b may be formed in a polygon such as square or hexagon, an ellipse, or a star-like configuration.

[0022] In the present invention, the cylindrical member may be provided with projections 8c, 9c, or 10c as cylindrical members 8, 9, 10 shown in Figs. 3 through 5. The projections 8c, 9c cut into the inner surface of the mounting hole 4 while the projections 10c cut into the peripheral portion around the mounting hole 4, thereby preventing the rotation of the cylindrical member 8, 9, 10 about the rod 2. Since the cylindrical member 8, 9, or 10 is fixed to the energy absorber 3, the cylindrical member 8, 9, 10 never rub against to the inner surface of the mounting hole 4 of the energy absorber 3, thereby preventing the wear of the inner surface of the mounting hole 4.

[0023] The projections 8c of Fig. 3 are each formed in a triangle and are disposed at the end of the cylindrical portion 8a in such a manner that the triangle has a steep-back angle toward the other end of the cylindrical portion 8a in order to allow the easy insertion of the cylindrical portion 8a into the mounting hole 4. The projection 8c may be longer than that shown in Fig. 3 and, for example, may be a trapezoid extending to connect to the flanged portion 8b.

[0024] The projections 9c of Fig. 4 are each formed in a triangle at the corner between the cylindrical portion 9a and the flanged portion 9b. The projections 10c of Fig. 5 are formed to project from the peripheral edge of the flanged portion 10b in a direction along the axial direction of the cylindrical portion 10a. Since each of the projections 10c has a sharp tip, the projections 10c can be easily cut into the peripheral portion about the mounting hole 4 of the energy absorber 3.

[0025] According to the present invention, the enlarged portion 2a can be formed by deformation process such as a US caulking and a tapping-vis caulking. The method for forming the enlarged portion is not limited in particular.

[0026] Fig. 7 is a sectional view of mounting structure for an energy absorber according to another embodiment of the present invention, Fig. 8a is a perspective view of a cylindrical member employed in this embodiment, and Fig. 8b is a sectional perspective view of this cylindrical member.

[0027] In this embodiment, the cylindrical member 20 comprises a cylindrical portion 21 and a flanged portion 22 integrally. The cylindrical portion 21 is provided with a pawl 23 extending inwardly from the end of the cylindrical portion 21. A rod 26 projecting from a trim 1 is provided with a concavity 27 formed in the outer surface thereof so that the pawl 23 engages with the concavity 27.

[0028] The cylindrical portion 21 is formed with slits 24 extending from the end thereof in parallel with the axial direction of the cylindrical portion 21 so that the cylindrical portion 21 can elastically deform in the radial direction thereof.

[0029] To mount the energy absorber 3 to the trim 1, the energy absorber 3 is arranged along the surface of the trim 1 in such a manner that the rods 26 are inserted into the mounting holes 4 of the energy absorber 3 and the cylindrical members 20 are then fitted and pressed onto the rods 26 to engage the pawls 23 with the concavities 27. As a result of this, the flanged portions 22 press the peripheral portions about the mounting holes 4 of the energy absorber 3.

[0030] The cylindrical portion 21 is formed in a tapered configuration, thereby facilitating the insertion of the cylindrical portion 21 into the mounting hole 4. In a state that the cylindrical member 20 is fitted to the rod 26 (Fig. 7), the outer surface of the cylindrical portion 21 is in close contact with the inner surface of the mounting hole 4.

[0031] The number of the slits 24 is preferably 4-6.

[0032] Fig. 9 is a sectional view of mounting structure of an energy absorber according to further another embodiment of the present invention and Fig. 10 is a sectional perspective view of a cylindrical member employed in this embodiment.

[0033] In this embodiment, the cylindrical member 30 comprises a cylindrical portion 31 and a flanged portion 32 integrally. The cylindrical portion 31 is provided with a concavity 35 circumferentially formed in the inner surface near the end of the cylindrical portion and with a pawl 33 inwardly extending from the end thereof. A rod 36 projecting from a trim 1 is provided with a convexity 37 circumferentially formed on the outer surface thereof so that the pawl 33 engages with the convexity 37.

[0034] The cylindrical portion 31 is formed with about four to six slits 34 extending from the end thereof in parallel with the axial direction of the cylindrical portion 31 so that the cylindrical portion 31 can elastically deform in the radial direction thereof.

[0035] To mount the energy absorber 3 to the trim 1, the energy absorber 3 is arranged along the surface of the trim 1 in such a manner that the rods 36 are inserted into the mounting holes 4 of the energy absorber 3 and the cylindrical members 30 are then fitted and pressed onto the rods 36 to engage the pawls 33 with the convexities 37. As a result of this, the flanged portions 32 press the peripheral portions about the mounting holes 4 of the energy absorber 3.

[0036] Though the cylindrical portion 31 is formed in a right circular cylinder shape in Figs. 9 and 10, the cylindrical portion 31 may be formed in a tapered configuration similar to the cylindrical portion 21. At least a portion of the outer surface of the cylindrical portion 31 is in contact with the inner surface of the mounting hole 4.

[0037] In any of the embodiments of Figs. 7 through 10 structured as described above, the energy absorber 3 can be mounted to the trim 1 without causing backlash. That is, the movement of the energy absorber 3 in a di-

rection along the surface of the trim 1 is prevented by the respective cylindrical portions 21, 31 arranged between the rods 26. 36 the inner surfaces of the mounting holes 4. The movement of the energy absorber 3 in a direction perpendicular to the surface of the trim 1 is prevented by the flanged portions 22, 32 of the cylindrical members 20, 30.

[0038] In the present invention, the cylindrical member may be completely perforated in the longitudinal direction thereof as shown in Figs. 11 through 15.

[0039] A cylindrical member 20A shown in Figs. 11, 12 has the same structure as the cylindrical member 20 shown in Figs. 7, 8 except that the cylindrical member 20A is completely perforated in the longitudinal direction thereof.

[0040] A cylindrical member 30A shown in Figs. 13, 14 has the same structure as the cylindrical member 30 shown in Figs. 9, 10 except that the cylindrical member 30A is completely perforated in the longitudinal direction thereof.

[0041] Since a cylindrical potion 21 of the cylindrical member 20A of the Figs. 11, 12 has a tapered configuration, two or more cylindrical members 20A can be compactly piled up by putting the nose thereof into the end of the cylindrical potion 21 of another one, so that the volume of the package thereof can be reduced. The pile of the cylindrical members 20A is useful in the operation for mounting the energy absorber onto the trim by using it in a manner that the pile is coaxially pierced with a pole (not shown) so that the cylindrical member 20A is delivered one by one by being guided with the pole.

[0042] The slits 24, 34 formed in the cylindrical potion as shown in Figs. 7 through 14 may partially extend in the cylindrical potion. When the cylindrical member 20, 30 are made up with an elastically deformable material such as the synthetic resin, the slits may be omitted.

[0043] Figs. 16 through 20 show an embodiment in which the energy absorber 3 is mounted to the trim 1 by fastening a pressing member to an anchor of the trim with a serrate portion.

[0044] In Fig. 16, an anchor 40 is provided to the trim 1 as an insert projecting from the trim 1. A serrate portion 41 is formed around the anchor 40.

[0045] A pressing member 44 has a flanged portion 45, a cylindrical projection 46 having a tapered configuration which is inserted into the mounting hole 4, and an engaging portion 47 which is inwardly projected from the front end of the projection 46.

[0046] The pressing member 44 is inserted into the mounting hole 4 so that the flanged portion 45 presses the periphery of the mounting hole 4. The anchor 40 enters the cylindrical projection 46 so that the engaging portion 47 engages with the serrate portion 41 whereby the pressing member 44 is prevented from slipping off, thereby preventing the energy absorber 3 from moving up and down in the figures. The projection 46 is in contact with the inner surface of the mounting hole 4, thereby preventing the energy absorber 3 from moving sidewards in the figures.

[0047] In Figs. 17, 18, an anchor 50 projected from the trim 1 as an insert is provided with a engaging portion 51 projected from the outer surface thereof. A pressing member 54 is composed of a flanged portion 55, a cylindrical projection 56 which is inserted into the mounting hole 4, and a serrate portion 57 provided to the inner surface of the projection 56. The pressing member 54 is pressed into the mounting hole 4 as the anchor 50 enters the cylindrical projection 56 to engage the serrate portion 57 with the engaging portion 51, so that the energy absorber 3 is fastened to the trim 1. The flanged portion 55 presses the energy absorber 3 from above. The projection 56 is in contact with the inner surface of the mounting hole 4, thereby preventing the energy absorber 3 from moving sidewards.

[0048] In Fig. 19, a pressing member 60 is composed of a flanged portion 63, a projection 62 inserted into the mounting hole 4, an insert 64 projecting from the projection 62 toward the trim 1, and a serrate portion 65 provided to the outer surface of the insert 64. An anchor 70 projecting from the trim 1 has an engaging portion 71 inwardly projecting from the nose thereof.

[0049] The pressing member 60 is inserted into the mounting hole 4 as the insert 64 enters the anchor 70 to engage the serrate portion 65 with the engaging portion 71, thereby mounting the energy absorber 3 to the trim 1.

[0050] A pressing member 60A has an engaging portion 65A on the outer surface of the nose of an insert 64A. An anchor 70A has a serrate portion 71A on the inner surface thereof. The structure of the pressing member 60A other than those described above is the same as that shown in Fig. 19. The same numerals appearing in Figs. 19 and 20 respectively denote the same portions.

[0051] In Fig. 19 and 20, the flanged portion 63 presses the energy absorber 3 from above, and the projection 62 is in contact with the inner surface of the mounting hole 4 to keep the energy absorber 3 from moving sidewards. The projection 62 may have solid structure.

[0052] Therefore, a caulking apparatus is not required according to the embodiments of Figs. 7 through 20, thereby facilitating the work of mounting the energy absorber 3.

[0053] It should be noted that the cylindrical members of the embodiments of Figs. 7-9 may be provided with projections for cutting into peripheral portions about the mounting holes 4 of the energy absorber just like the cylindrical members as shown in Figs. 3-5.

[0054] In the embodiment of Figs. 11-20, projections for cutting into the inner surface of the mounting holes 4 of the energy absorber may be provided to the cylindrical member or the pressing member.

[0055] The form of the serrate portion and engaging portion described above are not limitative to aforementioned embodiments so long as these portions can tight-

ly engage with each other. The form of the cylindrical potion, rod and anchor are not especially limitative so long as these portions can press the energy absorber and keep the energy absorber from moving sidewards.

[0056] Though the above-described embodiments relate to the case that the energy absorber 3 for the event of a lateral collision is mounted to the door trim of a vehicle, the present invention can be applied to a case that an energy absorber made of rigid urethane for protecting the head or the like of a vehicle occupant is mounted to a vehicle member other than the door trim. The energy absorber may be made of any material having impact absorbing property such as synthetic resin other than rigid urethane.

[0057] As described above, the present invention allows the easy mounting of the energy absorber to a member such as a trim. According to the structure of the present invention, the energy absorber can be mounted to the member without causing backlash and without using hot-melt adhesives.

Claims

1. Mounting structure for an energy absorber for mounting an energy absorber to a member, said member having a rod projecting from a mounting surface thereof for the energy absorber, said energy absorber having a mounting hole formed therein, and said rod being inserted into the mounting hole,

   wherein a cylindrical member is fitted onto said rod, and said cylindrical member has a cylindrical portion and a flanged portion overhanging from the cylindrical portion,
   wherein said cylindrical portion is inserted into the mounting hole of said energy absorber and said flanged portion is overlapped with a peripheral portion about the mounting hole, and
   wherein said cylindrical member is engaged with said rod.

2. Mounting structure for an energy absorber as claimed in claim 1, wherein said rod is provided with an enlarged portion at an end thereof whereby said cylindrical member is fastened to said rod.

3. Mounting structure for an energy absorber as claimed in claim 1, wherein said cylindrical portion is provided with slits extending from an end of said cylindrical portion, and
   wherein said cylindrical portion is provided with a pawl formed on an inner surface of a portion near the end of said cylindrical portion, said rod is provided with a concavity or convexity formed on an outer surface of said rod, and said pawl is engaged with the concavity or convexity whereby said cylindrical member is fastened to said rod.

4. Mounting structure for an energy absorber as claimed in any one of claims 1 through 3, wherein the outer surface of said cylindrical portion is in contact with the inner surface of said mounting hole.

5. Mounting structure for an energy absorber as claimed in any one of claims 1 through 4, wherein said cylindrical member has a projection which is engaged with said energy absorber to prevent said cylindrical member from rotating about said rod.

6. Mounting structure for an energy absorber as claimed in claim 5, wherein said projection cuts into said energy absorber.

7. Mounting structure for an energy absorber for mounting an energy absorber to a member, in which said energy absorber has a mounting hole, comprising:

   an anchor projecting from a mounting surface of said member to enter said mounting hole;
   a pressing member having a flanged portion pressing the periphery of said mounting hole and a projection entering said mounting hole;
   a serrate portion provided to one of said anchor and said projection; and
   an engaging portion provided to the other of said anchor and said projection to engage with said serrate portion.

8. Mounting structure for an energy absorber as claimed in claim 7, wherein one of said anchor and said projection is a cylindrical member and the other is an insert member inserted into said cylindrical member,
   wherein at least one of the inner surface of said cylindrical member and the outer surface of said insert member has a serrate portion.

9. Mounting structure for an energy absorber as claimed in claim 7 or 8, wherein said pressing member is in contact with the inner surface of the mounting hole of the energy absorber.

10. Mounting structure for an energy absorber as claimed in any one of claims 7 through 9, wherein said pressing member is provided with a projection which engages with said energy absorber to prevent said pressing member from turning around said anchor.

11. Mounting structure for an energy absorber as claimed in any one of claims 1 through 10, wherein said member is a trim of a vehicle.

12. Mounting structure for an energy absorber as claimed in any one of claims 1 through 11, wherein

said energy absorber is made of synthetic resin including rigid urethane.

Fig. 1

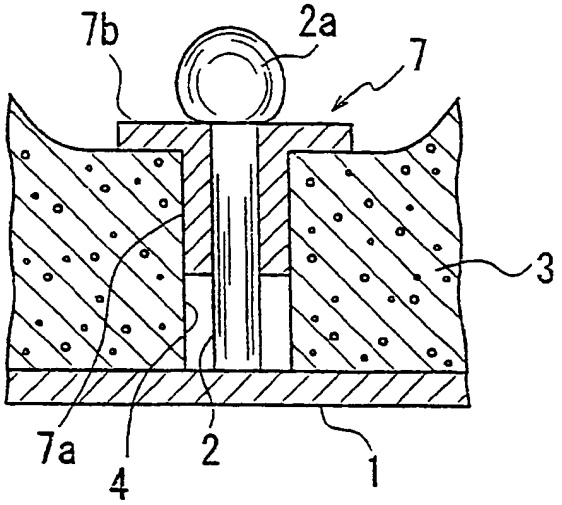


Fig. 2

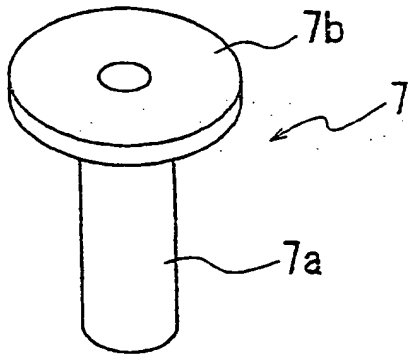


Fig. 3

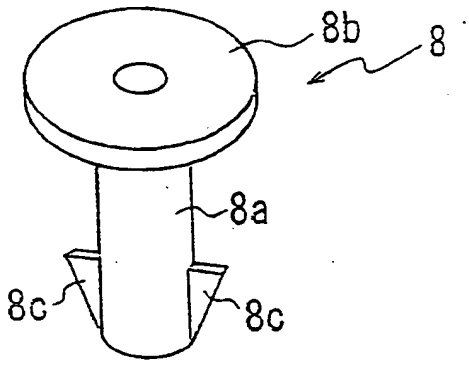


Fig. 4

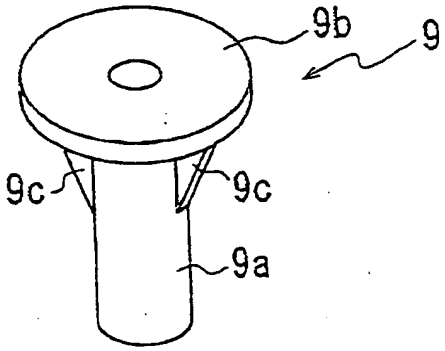


Fig. 5

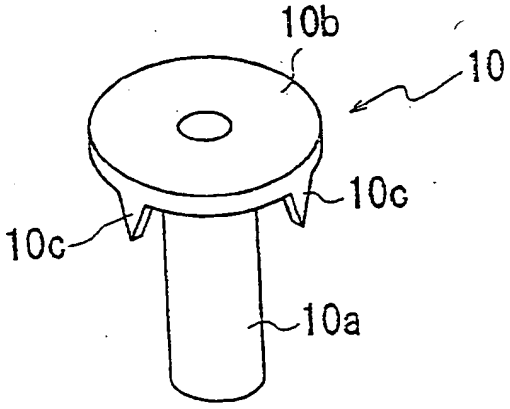


Fig. 6a

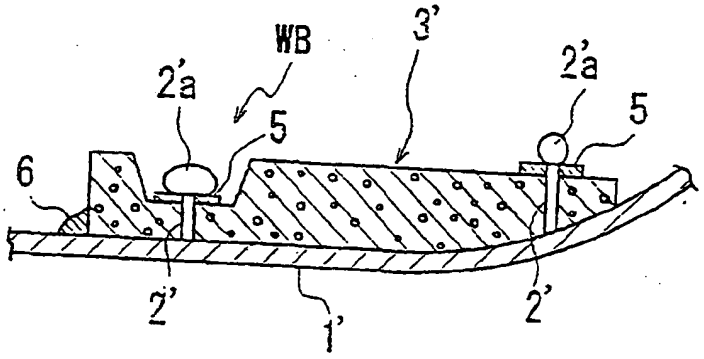


Fig. 6b

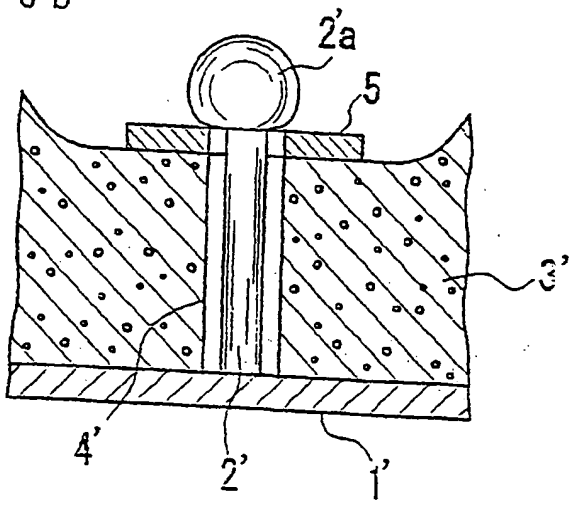


Fig.7

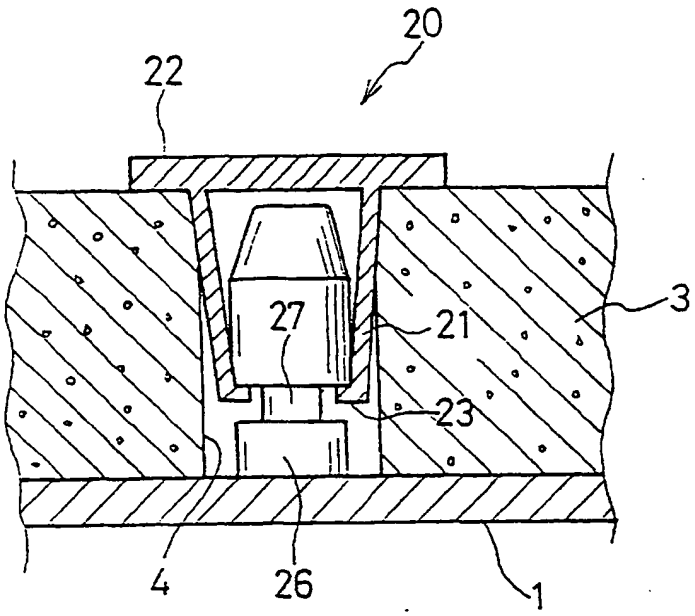


Fig.8a

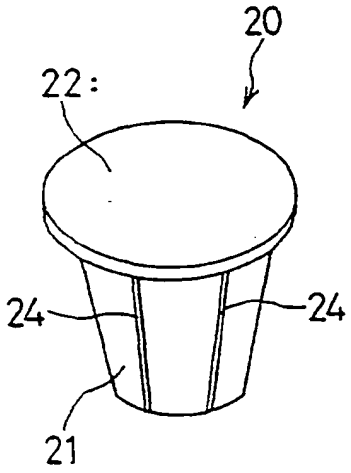


Fig.8b

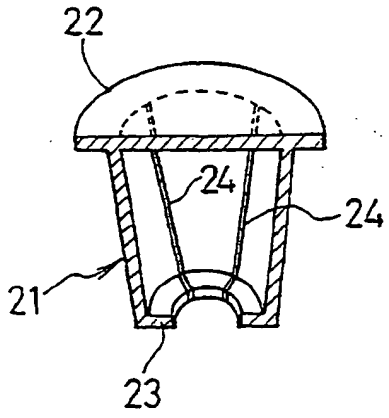


Fig.9

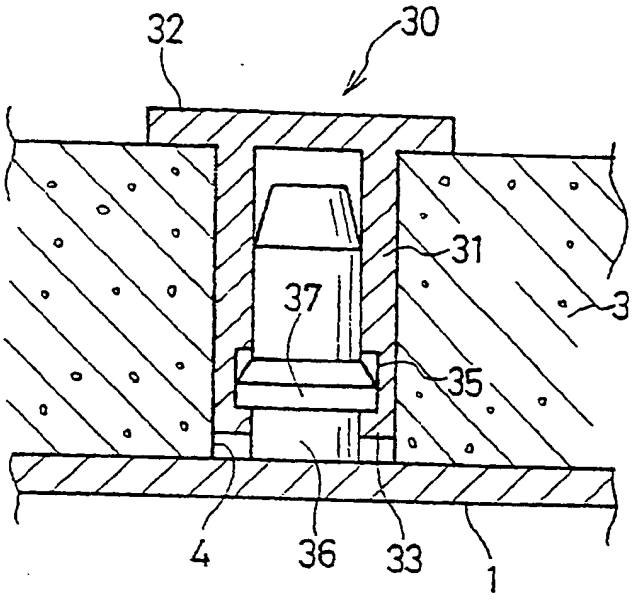


Fig.10

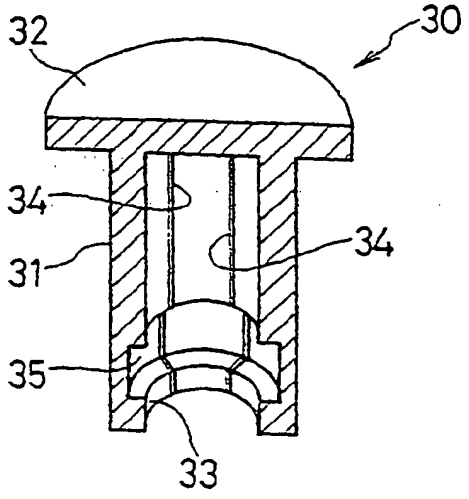


Fig. 11

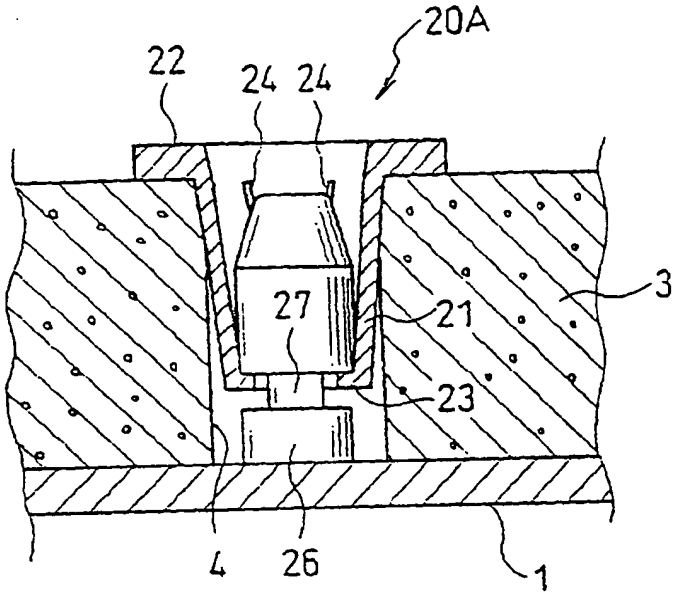


Fig. 12a

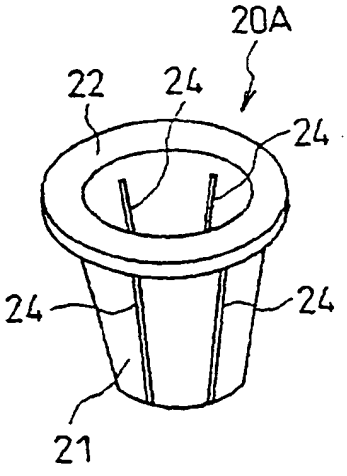


Fig. 12b

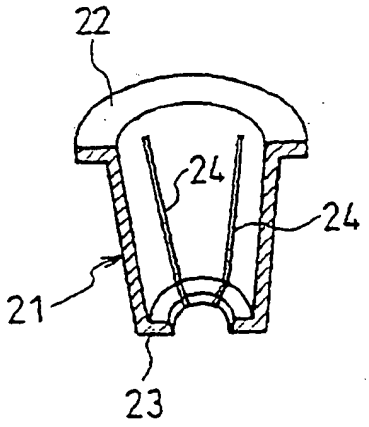


Fig. 13

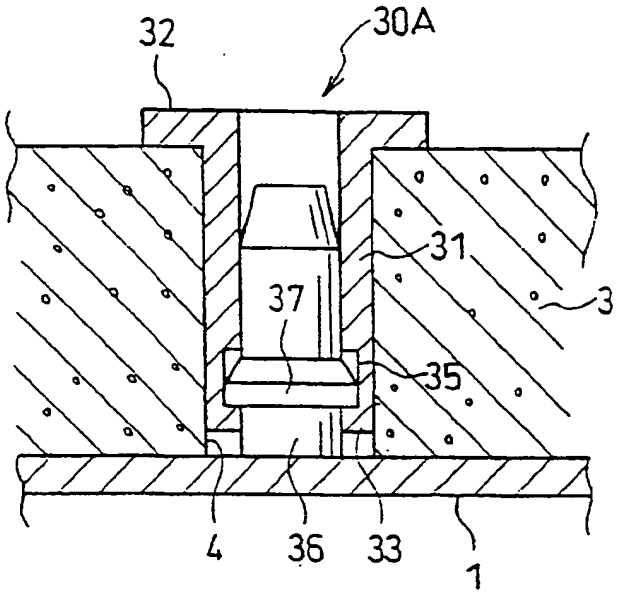


Fig. 14

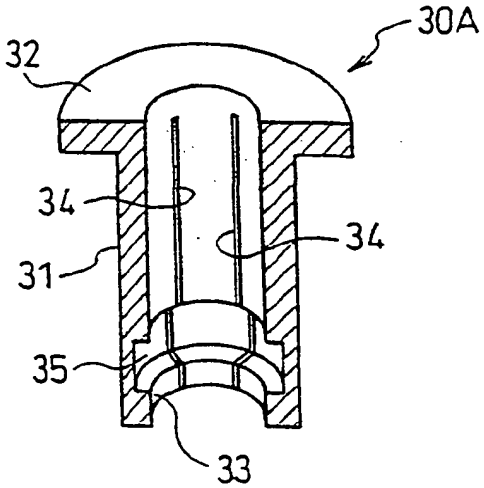


Fig. 15

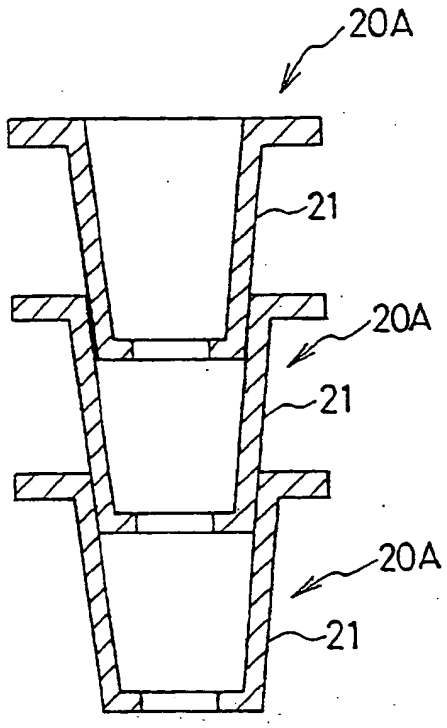


Fig. 16

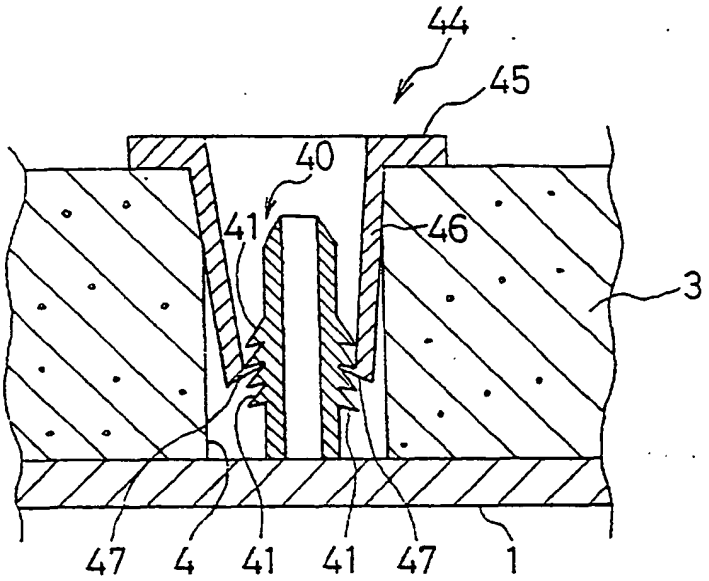


Fig. 17

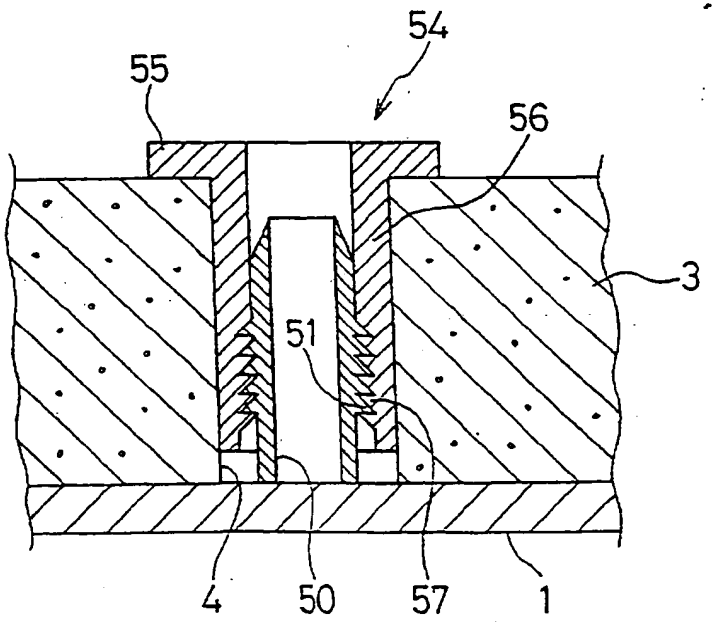


Fig. 18

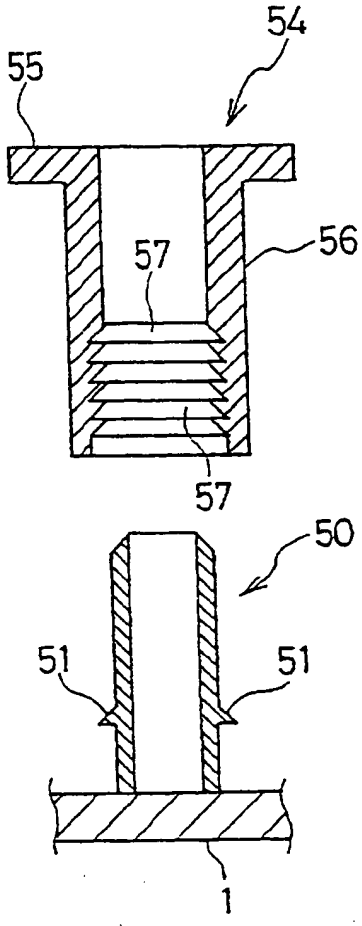


Fig. 19

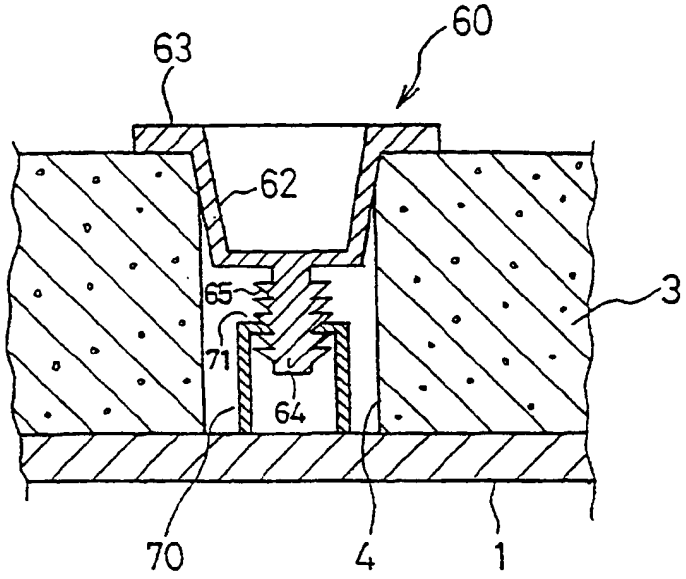
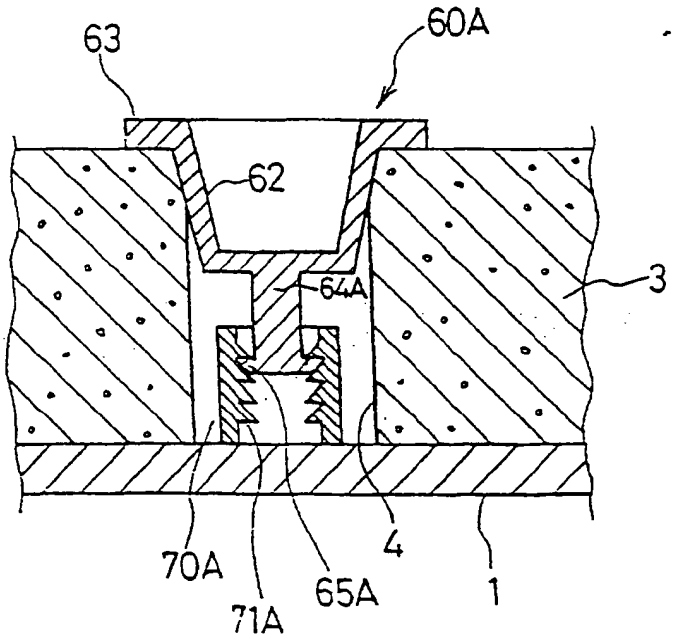


Fig. 20



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/02405

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B23P 19/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] B23P 19/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 7-32509, A (Toyo Tire and Rubber Co., Ltd.), 03 February, 1995 (03.02.95) (Family: none)	1-12
A	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No.114361/1991 (Laid-open No.54810/1993) (NIFCO INC), 23 July, 1993 (23.07.93) (Family: none)	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 May, 2000 (01.05.00)	16 May, 2000 (16.05.00)
Name and mailing address of the ISA: Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)